Towards a Good Problem Solver through Decision Making Model of Teaching: A Needs Analysis

by Prosiding 12

Submission date: 29-Dec-2022 03:46PM (UTC+0700)
Submission ID: 1987252047
File name: Prosiding_12.pdf (714.98K)
Word count: 4779
Character count: 27282

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Cite as: AIP Conference Proceedings **2479**, 020022 (2022); https://doi.org/10.1063/5.0099606
Published Online: 26 July 2022

Wasilatul Murtafiah, Marheny Lukitasari, Nurcholif Diah Sri Lestari, et al.

Towards a Good Problem Solver through Decision Making Model of Teaching: A Needs Analysis

Wasilatul Murtafiah[1, b)], Marheny Lukitasari[2, c)], Nurcholif Diah Sri Lestari[3, a)], Ika Krisdiana[1,d)], Muhammad Noor Kholid[4, e)]

[1]*Mathematics Education Department, Faculty of Teacher Training and Education, Universitas PGRI Madiun, Jalan Setiabudi No. 85 Madiun Indonesia*
[2]*Biology Education Department, Faculty of Teacher Training and Education, Universitas PGRI Madiun, Jalan Setiabudi No. 85 Madiun Indonesia*
[3]*Mathematics Education Department, Faculty of Teacher Training and Education, Universitas Jember, Jalan Kalimantan 37, Jember Indonesia*
[4]*Mathematics Education Department, Faculty of Teacher Training and Education, Universitas Muhammadiyah Surakarta, Gatak, Pabelan, Kec. Kartasura, Kabupaten Sukoharjo Indonesia*

[a)] Corresponding author: nurcholif.fkip@unej.ac.id
[b)] wasila.mathedu@unipma.ac.id
[c)] marheny@unipma.ac.id
[d)] ikakrisdiana.mathedu@unipma.ac.id
[e)] muhammad.kholid@ums.ac.id

Abstract. Being a good problem solver is a need in life in the present and future era. Therefore, producing prospective mathematics teachers to become problem solvers is essential to teach it to his students later. This study aims to describe the analysis of needs to be a good problem solver through a decision-making-based learning model. This type of research is descriptive qualitative with a research sample of 63 mathematics education students and 13 mathematics education lecturers. The data collections are through questionnaires distributed online and interviews. The research data analysis was carried out by grouping, reducing, describing, and concluding by first testing the validity of the data through triangulation of methods. The results of this study indicate that: (1) there are still many students who have difficulty in finding problem-solving ideas; they are not precise in choosing the right strategy and procedure for solving them so that it results in students not being able to solve mathematical problems well; (2) There are still many lecturers who have not provided opportunities for students to express, clarify and assess their solution ideas so that they can obtain correct problem solving; (3) There is no learning device designed that already explicitly so that students become good problem solvers. The needs analysis results indicate that it is necessary to develop a learning model based on decision-making.

INTRODUCTION

Problem-solving is a skill used to develop advanced mathematical thinking from previously learned knowledge to create new knowledge and expand further knowledge [1][2]. Being a good problem solver is indispensable in life in the present and future. Therefore, as the next generation of the nation, students must have problem-solving skills to decide solutions in dealing with problems that occur in daily life.

Problem-solving is a means by which an individual uses the knowledge, skills, and understanding he acquires to meet the demands of unknown situations [3]. Problem-solving is generally considered the most significant cognitive activity in a daily and professional context, where most people are asked and rewarded for solving problems [4]. Problem-solving will be more effective if the knowledge base and the application of that knowledge are the main principles of theory and practice [5]. Teachers must reform the curriculum, update curriculum standards, and

The International Conference on Mathematics and Learning Research (ICOMER) 2021
AIP Conf. Proc. 2479, 020022-1–020022-9; https://doi.org/10.1063/5.0099606
Published by AIP Publishing. 978-0-7354-4359-4/$30.00

continuously create problem situations to familiarize students to think [6]. A teacher should teach students knowledge and healthy thinking skills and knowledge to successfully solve problems, including problems in daily life.

Students' ability to solve problems still needs to be improved. It is evident in previous studies that most students are still weak in solving contextual math problems [7]. Furthermore, other studies stated that students with low self-esteem also have low communication skills on problem-solving. The low ability of students in solving the problem gives a signal for the college on teacher and training education to prepare their graduates to be skilled in solving problems. Therefore, producing prospective math teachers who can be good problem solvers is vital to teaching it later.

However, the facts show that the ability of prospective mathematics teachers is still low in solving problems. Students are still not thorough in communicating the solution to differential equations, which shows that there is still a lack of student ability to solve problems [8]. Students of prospective math teachers, even with high initial skills, are still less creative in solving problems, so it shows that the ability of students of prospective mathematics teachers to solve problems is still low in calculus material [9]. Students of prospective math teachers are also still low in solving geometry problems, characterized by only one student demonstrating creative mathematical reasoning [10]. These facts show that students' ability to solve differential equations, calculus, and geometry problems is still low, so it is necessary to find a solution.

One solution that can be offered to overcome the low ability of prospective math teachers in solving problems is to design a learning model. The learning model is a particular method to facilitate learning designed to improve learning outcomes associated with the standards required in the academic discipline by using a series of specially designed activities [11]. Therefore, the learning model in this research should be designed to improve students' problem-solving skills through developing students' decision-making. Decision-making is a thought to guide problem solvers to decide strategies and ways for someone to be a good problem solver. Decision-making is a series of activities to choose something from several alternative options to obtain the most suitable choice [12][13]. A prospective math teacher is expected to gradually choose the appropriate ideas and strategies to solve the problem

through the decision-making process.

The study literature shows that decision-making-based learning models aimed to improve students' ability to solve math problems for prospective mathematics teachers have never been reported by previous researchers. The previously developed learning models to improve mathematical problem-solving skills are still focused on students and not prospective mathematics teachers [14][15]. For this reason, it become important to develop a decision-making-based learning model that can improve mathematical problem solving skills. However, to develop the intended learning model, then a need to analyze is necessary for students and lecturers for the existence of this teaching model. Thus, the purpose of this study is to describe the needs analysis of decision-making-based learning model development for the prospective mathematics teachers to improve students' skills.

METHOD

Research Type and Subject

This type of research is descriptive qualitative to describe the analysis of needs to be a good problem solver through decision-based learning models. The subjects of this study were 63 students of mathematics education (coded as S1 to S63) and 13 lecturers of mathematics education (coded as L1 to L13) at the Faculty of Teacher Training and Education of PGRI Madiun University and Jember University. Students of the mathematics education study program at PGRI Madiun University and Jember University are from semesters 2, 4, 6, and 8.

Data Collection and Analysis

Data collection methods are through the online questionnaires followed by interviews. The Google Form facilitates the spread of the online questionnaire. The questionnaire needs to be a good problem solver through the learning model presented in Table 1.

TABLE 1. Needs Analysis Questionnaire

Aspect	Question
Needs analysis questionnaire for lecturers	
Perception of problem-solving	Which statement do you think is appropriate to describe the problem? (Non-routine problem although simple / Complex non-routine problem / Problem application / Problem story)
Problem-solving questions to students	Have you ever given problem-solving problems in your courses? (Once, in practice questions in reference books / Ever, in course assignments with problem-solving questions I developed myself / Ever in UTS questions / Ever in UAS questions / Never)
Student problem-solving skills	What do you think are the problem-solving skills of most of your students in the courses you can? (More than 80% of students have good problem-solving skills/ As many as 60% to 80% have good problem-solving skills/ Less than 60% of students have good problem-solving skills)
	What difficulties do students often face in solving problems? (Understanding problems / Finding your ideas to solve problems / Choosing the best problem-solving ideas among the options that have been identified / Implementing the selected settlement procedure / Assessing the fairness/reasonableness of the idea of solving)
Learning device	Do you already have learning tools specifically designed to teach problem-solving? (Already, the learning tools that I have are complete / Already, but the learning tools that I have are incomplete / Do not have)
Questionnaire analysis of needs for students	
Perception of problem solving	Which statement do you think is appropriate to describe the problem of problem solving (Non-routine problem although simple / Complex non-routine problem / Problem implementation / Problem story)
	During your time in the lecture, have you ever been faced with a problem, such as for problem solving? (Never, in practice questions in the reference book / Ever, in the course assignment / Never in the mid-test / Never in the final exams/ Never)
Decision making in resolving problems	When your lecturer asks you to solve a problem solving problem, are you asked to express your idea either orally or in writing? (Yes, always / Yes, often / Yes, sometimes / Never)
	When your lecturer asks you to solve a problem solving, are you asked to identify your idea either verbally or in writing? (Yes, always / Yes, often / Yes, sometimes / Never)
	When your lecturer asks you to solve a problem solving, are you asked to choose one of your best ideas, either verbally or in writing? (Yes, always / Yes, often / Yes, sometimes / Never)

After the dissemination of questionnaires, then conducted interviews on selected students and lecturers based on the data of questionnaires in Table 1. Furthermore, data analysis is done by grouping, reducing, describing, and concluding the need analysis data to be a good problem solver through decision-based learning models. Triangulation of methods between questionnaire data and interviews is a validity test used [16].

RESEARCH AND DISCUSSION

The distribution of the questionnaires to lecturers and students through the Google Form application is the starting point of this research. In addition to the questionnaire, researchers also conducted interviews to deepen the results of the study. The results of this study include an analysis of the needs of learning models for lecturers and students at Pgri Madiun University and Jember University with the following results and discussions.

Analysis of the Need for The Development of Learning Models for Lecturers

The analysis of the need for the development of a decision-based learning model is carried out on lecturers covering several aspects, among others: 1) the lecturer's perception of problem-solving, 2) the provision of problem-solving

problems by lecturers, 3) the ability of students in solving problems, 4) the difficulty of students in solving problems and 5) the readiness of lecturer learning devices in teaching problem-solving.

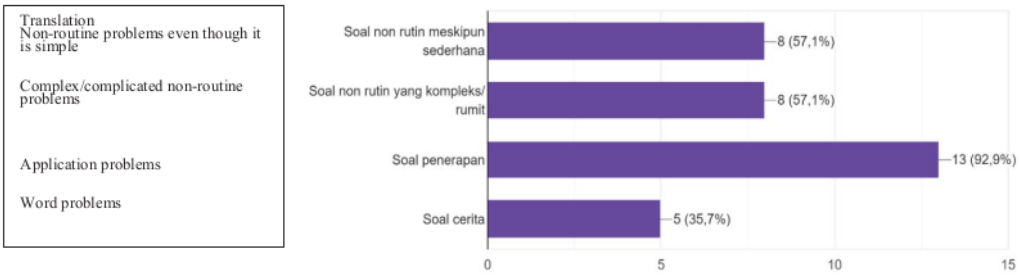


FIGURE 1. Perception about Problem Solving According to Lecturers

In Figure 1, it appears that as many as 13 (92.9%) lecturers state that the problem of problem-solving is a matter of application problem. 8 (57.1%) lecturers have the perception that a problem-solving problem is a non-routine problem even though it is simple and a non-routine problem complex / complicated. Others 5 (35.7%) lecturers have the perception that problem-solving is a matter of word problem. Furthermore, the interview results showed that the L2 lecturer stated, "Problem-solving is a problem that is not routine, and that has never been given to students before." Then the L4 lecturer argued that "the problem-solving problem is a problem resolved using non-routine procedures." In mathematics learning, problems are generally defined as situations or questions that do not have an immediate solution and require thoughts and challenges to overcome them [17][18]. A problem is when a person or group of people is asked to do a task that is not easy to resolve with a routine procedure [19][20]. This result implies that many lecturers have a different perception about what is problem-solving problems. Even so, most of them agree that applications-problem is a part of the problem solving's problem.

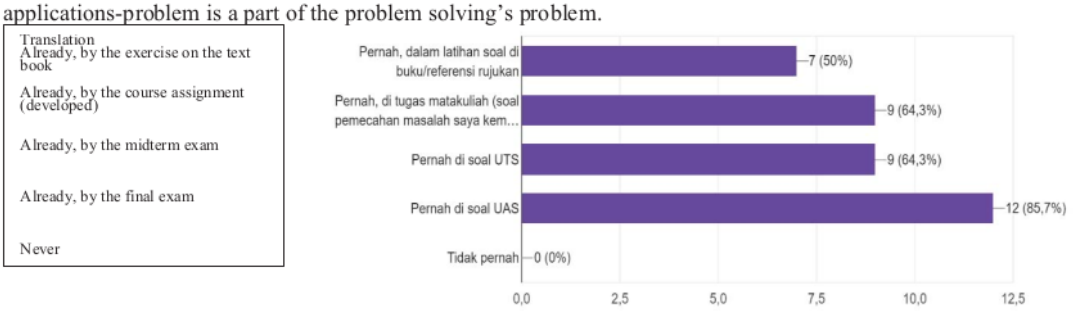


FIGURE 2. Giving Problem Solving Questions by Lecturers

Figure 2 showed the various ways of giving problem-solving to students. It appears that 50% of respondents gave problem-solving questions through the exercises in the book/reference. 64.3% of respondents gave problem-solving questions in the courses mastered in the course assignment and the midterm exam (UTS) questions. In comparison, 85.7% of respondents gave problem-solving questions in the final exam (UAS) questions. It showed that most lecturers give problems in problem-solving during the final exam of the semester. An interview with lecturer L3 supported this opinion. L3 stated that "I usually give problem-solving questions during the final exams because I want to know which students have good skills in the courses that I can." Then lecturers L5 and L8 also stated if it is happier to give problems during the final exam because they want to know students who understand the materials taught. The results showed that lecturers tend to give problems at the time of final exams and still rarely give problems during learning activities. The problem-solving skills should be trained for prospective teachers, considering that knowledge is part of the pedagogic content required to become a professional teacher [21]. Thus, students will also have experience learning to solve problems and develop their pedagogical content knowledge [22]. It suggests that lecturers should often give problem-solving questions during learning activities. In line with previous research, the design of learning tools to teach problem-solving for students needs to be done [23].

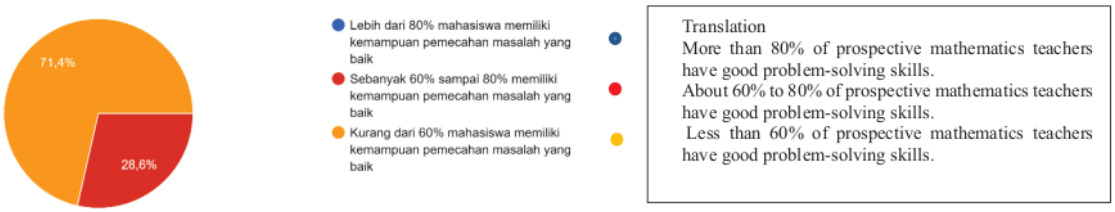


FIGURE 3. Students' problem-solving ability

In Figure 3, it appears that only 28.6% of lecturer respondents believe that as many as 60%-80% of prospective mathematics teachers on their course have good problem-solving skills. In comparison, 71.4% of students from the courses supported by less than 60% have good problem-solving skills. The results were also supported by an interview with a lecturer, L7, stating that "there are still few prospective mathematics teachers who can finish well when I give problems during exams." The lecturer L10 also stated that "prospective mathematics teachers can mostly work on procedural questions, but when I give steamy problems about development, few can solve them." The questionnaires and interviews show that there are still few prospective mathematics teachers who have good problem-solving skills. The condition is in line with the results of previous research that stated that there is still a lack of ability of prospective mathematics teachers in communicating problem-solving [8]. Previous research has also stated that prospective mathematics teachers' creativity is still low in solving problems [9] [24].

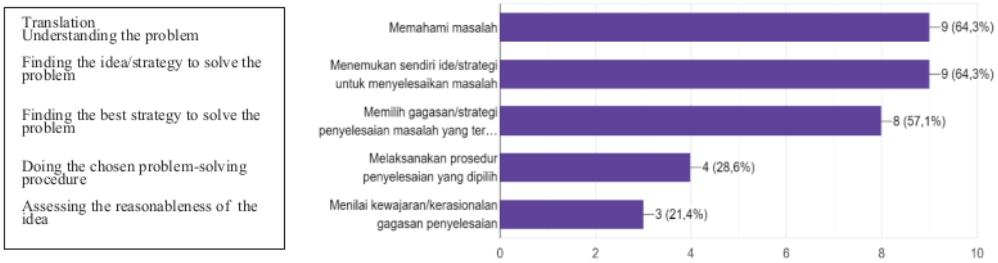


FIGURE 4. Student Difficulties in Solving Problems

In Figure 4, it appears that 64.3% of prospective mathematics teachers have difficulty understanding problems and find their ideas/strategies for solving problems. In comparison, 57.1% of prospective mathematics teachers have difficulty choosing ideas/strategies to solve problems. It also showed that there are 28.6% of prospective mathematics teachers solve problems. 28.6% of prospective mathematics teachers have difficulty implementing the chosen solution procedure to solve problems. There are 21.4% of prospective mathematics teachers who have difficulty assessing the fairness/reasonableness of the idea of solving problems. The results were also supported by L1, who stated that "most prospective mathematics teachers are still unable to understand the problem well, causing errors in its resolution." Similarly, L7 also stated that "prospective mathematics teachers have been weak in understanding the problem and still wrong in choosing the appropriate solution strategy." The difficulties experienced by these prospective mathematics teachers are on the stages of problem-solving, namely understanding, planning, and implementing strategies [25].

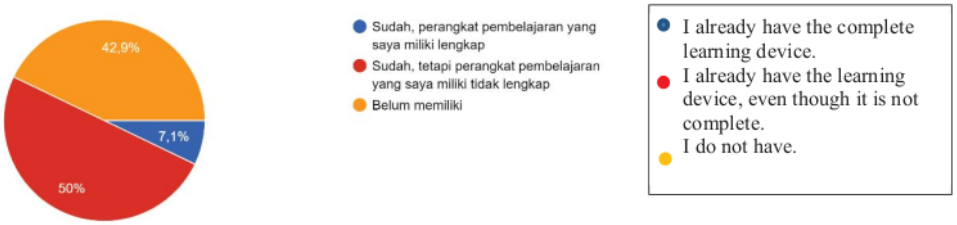


FIGURE 5. Problem-Based Learning Device

Figure 5 shows that 7.1% of lecturer respondents already have a complete problem-solving-based learning tool. In comparison, 50% of respondents already have problem-based learning tools but incomplete, and another 42.9% do not yet have problem solving-based learning tools. The results were supported by excerpts from interviews with L6 lecturers stating that "I still don't have the learning tools that I specifically designed to teach problem-solving to prospective mathematics teachers." In line with the Lecture, L9 said, "honestly, I do not yet have the learning tools to teach good problem solvers." These results indicate that the need is designed learning tools specifically designed to solve problems. Educators should be able to design learning processes that can facilitate prospective mathematics teachers to learn and implement effective learning models [11]. Implementing effective learning models allows learners to achieve higher grades, so that an educator should consider relevant learning models when designing learning [26].

Analysis of the Need for The Development of Learning Models for Prospective Mathematics teachers

The analysis needs to develop a decision-based learning model is conducted on prospective mathematics teachers covering several aspects, among others: 1) prospective mathematics teachers' perception of problem-solving, 2) the provision of problem-solving by lecturers, and 3) student decision making in solving problems.

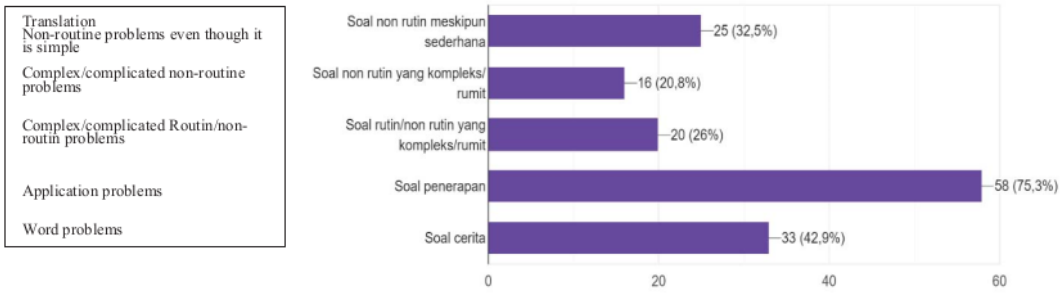


FIGURE 6. Perceptions of Problem Solving According to Prospective Mathematics Teachers

In Figure 6, it appears that 32.5% of prospective mathematics teacher's respondents who have a perception of problem-solving are non-routine though simple. There are 20.8% of respondents who have a perception that problem-solving is a complex/difficult non-routine problem. 26% of respondents perceive problem-solving as a complex/complex routine/non-routine problem, 75.3% of respondents perceive problem-solving as a matter of application. Another 42.9% of respondents perceive problem-solving as a words problem. As stated by S4, "the problem of problem-solving is a matter of application, mostly in the form of a story." S20 stated that "the problem I think is a difficult one." In addition, S17 stated that "if I think, the problem of problem-solving is a question of application." The opinion presented is still not following the definition of problem-solving, according to some experts. A problem is generally defined as a situation or question that has no immediate solution and requires thought and challenge to resolve [17][18]. A problem is a situation where a person or group of people is asked to do a task that is not easy to get resolved with a routine procedure [19][27]. A person is said to encounter a problem when he faces a question that he cannot answer or a situation that he cannot solve with the knowledge that is instantaneous for him [28].

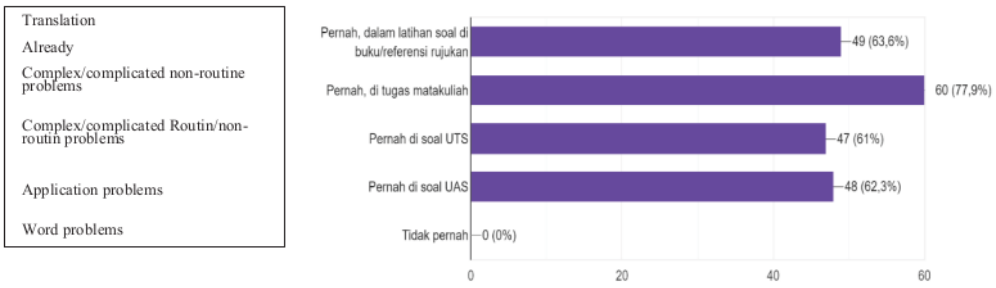
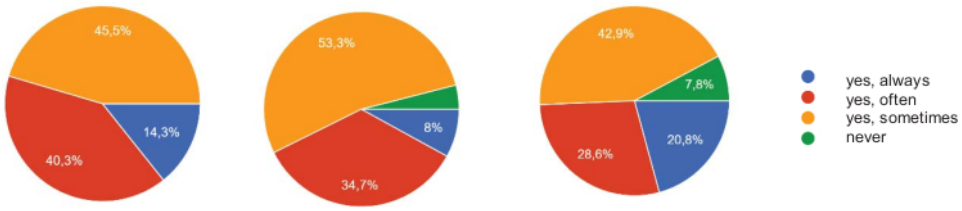


FIGURE 7. Giving Problem Solving Questions to Prospective Mathematics Teachers

In Figure 7, it appears that there are as many as 77.9% of prospective mathematics teachers respondents given problem-solving tasks on their college assignments. In comparison, 63.6% of respondents were given problem-solving tasks in the problem training in the book/reference, 61% of respondents were given problem-solving tasks in its questions. Another 62.3% of respondents were given problem-solving tasks in the final exam problems. The results were supported by S43, who stated that "we are often given problem-solving questions through assignments given by lecturers, which are usually group assignments." S35 stated that "lecturers usually give problem-solving questions in exams, both midterm and final exams." According to prospective mathematics teachers, the results showed that lecturers had given problem-solving questions through exercises, assignments, and exams. Based on the lecturer's opinion, the provision of problem-solving questions shows that there are still many prospective mathematics teachers who are less able to solve problems. However, the lecturer has correct what has been done because it has given problem-solving questions to prospective mathematics teachers. After all, the problem is used as a starting point in learning, so that prospective mathematics teachers are accustomed to developing their thinking skills [29].



a. Generating Idea b. Clarifying Idea c. Assessing Reasonableness Idea

FIGURE 8. Lecturer Asks Prospective Mathematics Teachers to make problem-solving Decisions

Figure 8 shows that 45.5% of prospective mathematics teacher respondents state that lecturers sometimes were asked by lecturers to express ideas in solving problems. In Figure 8b., it appears that their lecturers sometimes ask 53.7% of prospective mathematics teachers to identify ideas to solve problems. In Figure 8c., it appears that there are 42.9% of prospective mathematics teachers are sometimes asked by their lecturers to choose one of their ideas in problem-solving. The data above shows that condition where the lecturer rarely or only occasionally involves prospective mathematics teachers in generating ideas, clarifying ideas, and assessing the reasonableness of the idea. The excerpts of interviews with S47 was supporting the result. S47 states that "lecturers sometimes ask prospective mathematics teachers to express problem-solving ideas." According to the S33, he stated that “lecturers sometimes ask us to identify ideas or problem-solving strategies."

Furthermore, S50 stated that "lecturers rarely ask us to choose one of the problem-solving ideas, because finding one idea is difficult to let alone some hehe...”. The results show that prospective mathematics teachers have not been used to making decisions in solving problems correctly. They are rarely involved in generating, clarifying, and assessing the reasonableness of their idea. In other words, the lecturer still dominated the decision-making process in problem-solving. On the other hand, the thinking process in decision-making on the idea of completion is essential so that prospective mathematics teachers can get a good idea of completion through a series of stages of decision-making in order [12][30]. It means that one more result shows that prospective mathematics teachers' decision-making skills are needed to improve.

CONCLUSION

The results showed that there was still a slight difference in perception of the meaning of the problem according to lecturers and prospective mathematics teachers. The results of the needs analysis related to the development of learning models can be concluded that: (1) there are still many prospective mathematics teachers who have difficulty in finding problem-solving ideas; they are not precise in choosing the right strategy and procedure for solving them so that it results in prospective mathematics teachers not being able to solve mathematical problems well; (2) There are still many lecturers who have not provided opportunities for prospective mathematics teachers to generate, clarify and assess their solution ideas so that they can obtain correct problem solving; (3) There is no learning device designed explicitly, so that prospective mathematics teachers become good problem solvers. The needs analysis results indicate that it is necessary to develop a learning model based on decision-making.

ACKNOWLEDGMENTS

The author would like to thank the Directorate of Research and Community Service (DRPM), Ministry of Education and Culture of Indonesia, for the funding. We would also like to express our gratitude to the Teacher Training and Education Faculty of the University of PGRI Madiun, who has been permitted to carry out this research activity.

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